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Geology of Part of Sonora, Mexico,' by Mr. B. F. Hill. Both gentlemen are post-graduate students of Columbia University.

The rocks described by Mr. Finlay were sent by Mr. E. D. Self to Professor J. F. Kemp. The nepheline syenite is a very light-colored rock, containing, besides abundant nepheline and an orthoclase, small patches of dark-colored silicates. Under the microscope these are seen to be ægerine augite intergrown with hornblende, and accompanied by magnetite and apatite. Titanite is abundant, with the faces (1-2-3) well developed, and some zircon occurs. The tinguaitite associated with this syenite is a holocrystalline porphyritic dike rock, with large phenocrysts of orthoclase, twinned on the Carlsbad law, tabular in habit, parallel to the clinopinacoid. The ground mass which gives the rock an even, dark green color, consists of a felt of tiny blades of ægerine and orthoclase. The ægerines are at times grouped together in bundles around small patches of biotite.

Mr. Finlay then briefly discussed the distribution of similar rocks in the various portions of the United States, and exhibited a very instructive series of comparative charts of the chemical composition of the rocks examined and those of allied groups, the charts being constructed on the principles of the graphic method devised by Professor Hobbs, as worked out by Mr. Finlay.

The second paper, that of Mr. Hill, also treated of Mexican rocks, and the same geographical maps were employed to illustrate both papers. Little has been written about the coal-bearing rocks and their associated eruptives in the state of Sonora, Mexico. The work done by Professor Dumble and his associates has thrown considerable light on some of the problems.

In the district investigated are representatives of nearly all the formations from the Archæan granites to the Quarternary sands and gravels. The most important division, however, is the Triassic. The slates, sandstones, quartzites, etc., with coal seams, make up the lower or Bananca division of the Triassic, while an immense series of associated eruptives, including andesites, dacites, tuffs, andesitic,

conglomerates, etc., is considered the upper division. To the series of eruptives the name of Lista Blanca has been given. The Lista Blanca has hitherto been considered post-Cretaceous.

In addition to the pre-Cretaceous eruptives, there are numerous intrusives and flows of diorites, rhyolite, and basalt, and in one instance, trachite. It is probable that these are mostly of Tertiary age. The diorites exert a very noticeable effect on the formation of the ore bodies of the region.

Specimens of all the eruptives were brought to New York and studied by Mr. Hill, in thin section, under the microscope. A series of chemical analyses of the type rocks was made and a very clear relation established between the magmas of the different flows. The remainder of the paper dealt with details on the petrographic characteristics of the rocks.

Both papers were discussed by Professor Stevenson, Professor Kemp, Dr. Julien and Dr. White.

THEODORE G. WHITE,
Secretary of Section.

DISCUSSION AND CORRESPONDENCE.

MR. TESLA AND THE UNIVERSE—HUMAN
ENERGY AND HOW TO INCREASE IT—
HIS PHILOSOPHIZING QUESTIONED.

MR. NIKOLA TESLA has written a long article in the *Century Magazine* for June with the title 'The problem of increasing human energy, with special reference to harnessing the sun's energy.' The paper is profusely illustrated with impressive cuts of electrical experiments which, at first sight, seem convincing. Most readers of the *Century* looked at the striking cuts and glanced at some of the head lines of the article such as 'Development of New Principle'; 'Production of Immense Electrical Movements'; 'The Earth responds to Man'; 'Interplanetary Communication now probable,' and accepted the headlines on the testimony of the cuts; or else took it frankly for granted that so long an article must certainly prove a great deal.

The present writer has lately gone over the text of the article, pen in hand, and herewith

presents a small portion of his notes. They seem to him to show that the article in question is composed, essentially, of three different kinds of writing. The first kind describes Mr. Tesla's experiments in electricity and shows what he has already accomplished. This work is, no doubt, important. Its value will be appraised by experts. The present writer has no claim to be considered an electrical expert and does not attempt to give an estimate of the achievements referred to. The second describes what Mr. Tesla expects to accomplish in the future. His prophecies are so sanguine, in many cases, that even a general reader may presume to compare them with the comparatively small things already accomplished and to point out how very unlikely it is that any great part of his expectations will be realized within any reasonable future—within Mr. Tesla's own lifetime, for example.

The third element of this article consists of philosophical arguments about things in general—about human life—what it is—the future of the solar system—the solidarity of the human race—the Christian religion—vegetable food—theoretical dynamics—athletics in colleges—drinking water—ozone—education of women—ice—fertilizers—insanity—warfare—flying machines—iron manufacture—aluminium—liquid air—self acting engines—the inhabitants of Mars—etc., etc., etc.

Now these and other matters are interesting in themselves. We are all anxious to obtain new light upon them. We are all more or less competent to judge the conclusions of other people regarding them. It is not too much to say that this portion of Mr. Tesla's paper is in the main so trivial, so superficial, so obviously weak, as to throw doubt upon the whole essay. Many of the subjects treated are the oldest problems of the human race. They have been discussed by every philosopher since Aristotle. It is fairly astonishing to see Mr. Tesla's reasonings in print at this day. They compare with the logic of giants like Spinoza, Kant, Lord Kelvin, Herbert Spencer, and the rest as a baby's prattle to the 'Summa Theologiæ.'

If this judgment seems too harsh the following paragraphs will fully confirm it. No discourtesy is meant to Mr. Tesla. But his paper

has been printed. It now belongs to his readers. He must allow them to compare his philosophizing with that of his great predecessors and with the dicta of common sense.

The paper begins by asking profound questions with regard to human life. Whence comes it? What is it? Whither does it tend? "*Though we may never be able to comprehend human life, we know certainly that it is a movement, of whatever nature it may be,*" is Mr. Tesla's answer. A movement?—one movement? Are we sure it is a movement, and nothing else? "*Hence, wherever there is life, there is a mass moved by a force.*" A mass? A force? Why not masses, forces, hundreds of them? These beginnings which seem so definite lead to the conclusion that life is a *rhythm*, but this conclusion is at once dropped for the utterly antagonistic conception that man, mankind, is '*a mass urged on by a force.*' A force will urge a mass onward, not swing it rhythmically. We need not linger over this discrepancy, though there might be something to say, if it were worth while.

Mankind is then conceived as *one* physical mass; and Mr. Tesla's proof that this is a true conception is derived from the fact that every one of us feels sympathy with a friend who is hurt. Here is a mixing of two worlds—the world of matter and the world of feeling—which does not tend to clearness. The man born blind thought the sunset like a pleasing friendship. Swedenborg in his idea of the Grand Man who is the sum and integral of all individual men has put the question in a much truer light; but let us pass on. Man is, according to Mr. Tesla, '*a mass,*' one physical mass. Call this physical mass *M*. *M* is a quantity which can be expressed in tons or in ounces. Mankind is '*impelled in one direction*'—one direction!! by a force *f*, "*which is resisted by another force R, acting in a direction exactly opposite.*"

The idea in Mr. Tesla's mind is apparently that the force *R* is the reaction of the first force *f*. But every reaction is not only opposite to its action but equal to it, according to Newton. Not so in Mr. Tesla's universe. Reactions are opposite to, but less than actions. There is an effective force left over, which, in

his scheme, imparts a velocity V to mankind, *M.* "*Human energy will then be given (measured) by the product $\frac{1}{2} MV^2$, in which M is the total mass of man in the ordinary interpretation of the term 'mass,' and V is a certain hypothetical velocity which, in the present state of science, we are unable exactly to define and determine.*" How learned all this looks! and how foolish it all is! Mankind has a physical mass, no doubt. The energy of mankind is the sum of a million different energies, of very different qualities as well as of different amounts—spiritual as well as physical. These different energies, being of different kinds, cannot be expressed by a single term. Mr. Tesla's algebraic formula is mere solemn rubbish. It has absolutely no meaning.

There are three ways of increasing human energy, Mr. Tesla says: I. To increase the mass and energy of mankind more children must be born, fewer individuals must die, and the children must be of '*higher velocity*' than the parents (and *velocity* Mr. Tesla takes as exactly equivalent to *enlightenment*). Here Mr. Tesla pauses to discourage college athletics, and to say that although whisky, tea and tobacco shorten human life, yet he does not think that vigorous measures should be taken to suppress the habits of using them. On the contrary he would leave whisky alone, and improve the quality of drinking water. '*Gambling, business-rush, excitement * * * uncleanness * * * laxity of morals * * * the society-life, modern education and the pursuits of women*' and other matters tend to diminish the mass of mankind, but want of food is the chief cause.

Cattle are food of '*low velocity*' (enlightenment) Mr. Tesla says, and he does not approve of raising cattle, therefore. '*It is certainly preferable to raise vegetables.*' Here he has forgotten his basic principle, unless, indeed, he is prepared to prove that turnips are food of '*high velocity*,' *i. e.*, enlightenment. Here, again, as in the case of rhythmic motion, he no sooner lays down a principle than he abandons or neglects it for something quite different. However his vote is for vegetables, and more are wanted. To fertilize the soil more nitrogen is needed. He has an electric method for obtaining nitrogen from the atmosphere (so has Sir William Crookes) and the world's food sup-

ply is safe. All this is very well known. There is nothing new about it except the solemn manner in which it is said.

II. The second point is to reduce the force that retards the human mass. This force is a compound of ignorance, stupidity, imbecility, insanity, religious fanaticism, etc. It is not so simple then as Mr. Tesla's '*force R*' with which he began. Warfare is a retarding force but Mr. Tesla thinks it will be with us for some time yet, and indulges in a short excursion on flying-machines. "*The flying-machine is certainly coming and very soon. I see no reason why a ruling power like Great Britain might not govern the air as well as the sea. I do not hesitate to say that the next years will see the establishment of an 'air-power,' and its center may not be far from New York*" (possibly in Mr. Tesla's laboratory?). After a couple of pages devoted to warfare, harbor-defense, flying-machines, foreign invasion, international agreements, eternal justice, prehistoric man and his weapons, Mr. Tesla concludes that future battles will be decided by matching one complicated machine (say British) against another (say Russian).

"*Machines will meet in a contest without bloodshed, the Nations being simply interested, ambitious spectators. When this happy condition is realized peace will be assured.*" "*Bloodshed,*" Mr. Tesla thinks, "*will ever keep up barbarous passions.*" Hence we must '*produce a machine capable of acting as though it were a part of a human being.*' Such a machine may be destroyed but no blood will flow. Mr. Tesla has not yet produced a machine of the sort, but he means to do it.

He tells us that as a boy he noticed that whatever he thought of he saw. He visualized words in his mind. By attention he discovered that every occurrence in his mind was suggested by some previous outside occurrence or object. Hence, he was not a free agent, but played upon by his environment. He was the sport of the universe—an automaton. "*I have demonstrated, to my absolute satisfaction, that I am an automaton endowed with power of movement, which merely responds to external stimuli beating on its sense-organs, and thinks and acts and moves accordingly.*" He may be an automaton; but if he thinks that the foregoing argument proves

it, he is no logician. Being an automaton himself Mr. Tesla proceeded to make another automaton. He consented to make it full-grown to save time. It was also unnecessary to endow it with the power of propagating its kind, since Mr. Tesla himself could make more machines when he wanted them. He likewise consented to make it without a mind, because a mind *'I could easily embody in it by conveying to it my own intelligence.'*

With these slight differences from the Garden of Eden Mr. Tesla's workshop has turned out a kind of electrical boat or animated bath-tub (see the cut) whose movements can be controlled from a distance. This machine *'behaved just like a blindfolded person obeying directions received through the ear.'* It had a *'borrowed mind.'* In fact, it had no mind at all, except in Mr. Tesla's confused terminology. It had the same kind of a mind as a Waltham watch. It is now Mr. Tesla's intention to build an *'Automaton'* *'which will have its own mind.'* *"It will be capable of distinguishing between what it ought and what it ought not to do."*

Of course, such words are merely quibbles. In exactly the same sense a steam-engine has its own mind, and distinguishes what it ought from what it ought not to do. So did Maelzel's mechanical duck. So did Babbage's calculating engine. So does every device. Either the words mean nothing new; or else they are deceptive quibbles. It does not mend matters to say: *'my ideas on this subject have been put forth with deep conviction, but in a humble spirit.'*

Universal peace will be realized, he says, *"when all darkness shall be dissipated by the light of science, when all nations shall be merged into one, and patriotism shall be identical with religion, when there shall be one language, one country, one end, then the dream will have become reality."* To bring about these desirable conclusions, an automatic fighting machine is necessary. Mr. Tesla is now engaged on the question automatically.

III. But all this while the main point has been lost sight of in divagations. How to increase the forces moving the human mass is the question. For reasons not adduced Mr. Tesla declares that *'the resultant of all these forces is always in the direction of reason.'*

Every individual man is an automaton, we have seen, and will act unreasonably if played upon by certain forces. But mankind, which is made up of men, always acts reasonably. 'Tis strange; one seems to recall instances from history that refute the assertion. And indeed, Mr. Tesla himself does not really believe it. What is this busy world, he asks, but *'an immense clock-work?'* A *'reasonable'* clock-work! He finds, finally that *"the great problem of increasing human energy is answered by the three words: Food, Peace, Work."* *"These three words,"* he says *"sound the key-note of the Christian Religion."* One had supposed that Faith, Hope and Charity were the key-notes of the Christian religion; and that this religion had no message at all to a world of automatic men.

With a touching little eulogy on iron, and the prediction that aluminum is soon to take its place, and a good word for coal and for gas-engines, he passes on to the question of obtaining energy direct from the sun, and discusses the *"possibility of a self-acting engine or machine, inanimate, yet capable, like a living being, of deriving energy from the medium."* His conclusion is that it is possible though it cannot be produced for a long time yet. It is not pressing, then, to discuss his results. We will wait until some are forthcoming.

The next paragraphs of Mr. Tesla's long paper are taken up with the description of his experiments on electrical matters, wireless telegraphy (which Marconi independently discovered and has made practical), etc. Into these we will not follow him, except to say that he claims to be able to produce electrical effects on the planets Venus or Mars by methods which he is very careful not to explain. He expects an answer, too: *"That we can send a message to a planet is certain, that we can get an answer is probable; man is not the only being in the Infinite gifted with a mind."*

We might go on page by page, pointing out error, extravagance and bathos like the preceding. There seems to be no special need to go further. It should be evident to any impartial reader that the value of Mr. Tesla's general philosophical speculations and opinions is exactly *nil*. The value of his work in elec-

tricity must be judged by experts. The weight of his predictions as to future discoveries would be greater if his judgment on things in general were less unsound. It is passing strange that such loose reasonings can find a publisher. It is to be hoped that they will gain little credence from his readers. A line from Plato's Republic applies here (changing a word) to wit: "I verily believe that it is a more venial offence to be the involuntary cause of death to a man than to deceive him concerning scientific truth."

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BOTANICAL NOTES.

A NEW LABORATORY MANUAL.

DR. CLEMENTS and Principal Cutter, the former of the botanical staff of the University of Nebraska, and the latter of the Beatrice (Nebr.) High School have brought out what must prove to be a very helpful book for those teachers of Elementary Botany who wish to give their pupils a good course in laboratory work. There has been an increasing demand on the part of University professors that the high schools should lay such a solid foundation in the sciences that the subsequent work in the university could safely be built upon it. This has wrought a radical change in the methods of teaching chemistry and physics in the high schools which fit their pupils for university entrance. For many years some of the botanists have been demanding laboratory training in elementary botany for Freshmen entrance, but while the schools have made some progress, it is a curious fact that no serious attempt has hitherto been made to supply the high schools with a scientific manual comparable to the many excellent works of this character in chemistry and physics.

The authors of the 'Laboratory Manual of High School Botany' have attempted to make a book which is at once practicable in the average high school, as well as strictly scientific. The pupil who covers the work here laid out will be prepared to go forward in college and university classes without the necessity of unloading and unlearning a lot of rubbish, while at the same time if he should go no further with his studies he has had the satisfaction of knowing that he is in the possession of a considerable

body of useful information in regard to the structure and actions of plants. The general plan of the book may be obtained by a glance at the titles of the chapters, as follows: General Directions, Plant Structure, or Histology, Structure and Classification, Phytogeography, Synopsis of the Larger Groups of the Vegetable Kingdom, Physiology, Appendix (containing suggestions to teachers), and Glossary.

ORIGIN OF THE HIGHER FUNGI.

MR. GEORGE MASSEE, the well-known mycologist of Kew, speculates (in Linn. Soc., *Jour. Bot.*, vol. xxxiv., p. 438) as to the origin of the group of fungi known as the Basidiomyceteae, which includes those genera generally regarded as the highest of the hysterothytes, viz, the puff-balls and their relatives, and the various forms of toadstools and mushrooms. Finding that the conidial fructification of certain Ascomyceteae bears some resemblance to the spore-bearing tissues of the Basidiomyceteae, he finds a series of more or less obvious gradations, and arrives at the conclusion that there is a genetic connection between them. According to this view some plants are Ascomyceteae as to their ascigerous, and Basidiomyceteae as to their conidial fructifications. While ingenious, it is not likely that this theory will be generally accepted.

SUPPLEMENT TO NICHOLSON'S DICTIONARY OF GARDENING.

STIMULATED, perhaps, by the publication of Bailey's 'Cyclopedia of American Horticulture,' the publisher of Nicholson's 'Dictionary of Gardening' (Gill, London) announces a '1900 Supplement' which is to appear in two volumes. The first of these supplementary volumes has come to hand, and fully justifies the statement of the publisher as to the quality of subject matter and mechanical execution. The illustrations are superb, in many cases being reproduced directly from photographs. Upon the appearance of the second volume a more extended notice will be made.

NEW EDITION OF PRANTL'S LEHRBUCH.

DR. PAX of Breslau has brought out the eleventh edition of the well-known 'Lehrbuch der Botanik' of the lamented Dr. Prantl, first